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SECTION OF GEOLOGY AND MINERALOGY

FEBRUARY 4, 1946

DOCTOR FRANCO RASETTI, Professor of Physics, Laval University, Quebec: *Problems of Cambrian Stratigraphy and Paleontology in Quebec.* (This lecture was illustrated by lantern slides.)

The south shore of the St. Lawrence, from a few miles above, to more than 250 miles below, Quebec City, is occupied by a complex of red and green shales, with interbedded sandstone, quartzite, and limestone conglomerate. These rocks form the main portion of Logan's classic "Quebec group," and are now usually known as the "Sillery" and Lévis formations. Logan considered the latter the older of the two, but later Ells showed that the "Sillery" underlies the Lévis. The Lévis includes the celebrated graptolite-bearing black shales, and is geographically limited to a narrow area in the vicinity of the type locality. The "Sillery" is almost totally barren of fossils in place, although Cambrian faunas of several ages occur in the conglomerate boulders.

On the basis of a few finds of graptolites and of the supposed conformable relation between Lévis and "Sillery," it has been generally assumed that the "Sillery" is Lower Ordovician or, partly, Upper Cambrian. This assumption was questioned, for the first time, by Ulrich and Cooper, who restudied the brachiopod *"Obolella" pretiosa*, described by Billings from outcrops of the "Sillery" at the type locality

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and on the Chaudière River. They concluded that the species belongs to the genus *Botsfordia* and is Lower Cambrian.

The writer, believing that no advance toward the solution of the problem could be made with the fossil evidence on hand, searched the exposures for additional fossils. This search was rewarded with the discovery of a small Lower Cambrian trilobite fauna in place, a few miles east of Lévis (Rasetti, 1945a). Fortunately, the fossiliferous horizon occurs in an excellent section of more than 1600 feet of strata in clearly recognizable order. Later, the same section yielded the graptolite *Callograptus* about 250 feet above the Lower Cambrian fossil zone (named the *Austinvillia* zone from one of the characteristic trilobites). Finally, still 1300 feet higher in the section, were collected two species of *Orthis* and a new trilobite. These finds prove that the strata in this section—all apparently in conformable succession—range in age from Early Cambrian to Early Ordovician. The shales throughout the section present little difference in lithology; hence, the presence of rocks of widely different ages had never been suspected. A few feet above the *Austinvillia* zone lies a conspicuous limestone conglomerate bed, whose boulders yield many Lower Cambrian fossils. It is tentatively assumed that this conglomerate marks the base of the Canadian. Under this assumption, the entire Middle and Upper Cambrian would not be represented in the area, although no erosional disconformity can be observed at the base of the conglomerate.

The typical "Sillery" of the Chaudière (1500 feet of red shale and sandstone are excellently exposed there, with *Botsfordia pretiosa* at the top) does not seem to be represented in the section just described; hence, it must be either entirely older or entirely younger than the beds east of Lévis. The latter assumption cannot be accepted, since the described beds east of Lévis are succeeded by the Lévis formation, with its characteristic fossils. We conclude that the beds on the Chaudière are older, hence, entirely Lower Cambrian. The writer proposes a new name, Charny formation, for these Lower Cambrian beds, since the name "Sillery" has been applied both to Lower Cambrian and to Lower Ordovician strata, and its further use would cause confusion. For the Lower Ordovician strata underlying the Lévis, the old term Lauzon, introduced by Richardson and later abandoned in favor of "Sillery," may be revived.*

* A detailed account of the stratigraphy of the Lévis-Chaudière area will be published in the Bulletin of The Geological Society of America.

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A puzzling problem in the area here discussed is the origin of the numerous beds of limestone conglomerate with exotic boulders. These conglomerates occur at several places on the south shore of the St. Lawrence, and seem to be all of Early Ordovician age. Those in the Lévis shale at Lévis are celebrated for their rich trilobite faunas (Rasetti, 1944, 1945b). The others, farther east, seem to belong to the Lauzon; they are usually associated with sandstone and quartzite, often in exceedingly thick beds. The limestone boulders in these conglomerates yield a variety of Lower, Middle, and Upper Cambrian faunas; sometimes all these faunas occur in the same bed (Rasetti, 1945c). These limestones of different ages are all similar, lithologically, and also have in common the fact that no strata of corresponding lithology and age are now known anywhere in Quebec. An attempt toward the explanation of the origin of these conglomerates has been made by Bailey, Collet, and Field (1928). The strata from which the boulders came may now be buried under the overthrust mass of the Charny, Lauzon, and Lévis. In the foreland (northwest of the St. Lawrence—Champlain fault), no Cambrian strata were sedimented, the Trenton overlying the pre-Cambrian gneiss. However, the slope of the sea bottom may have been very steep, and such Cambrian strata may have existed in the area, now buried under the thrust sheet, a few tens of miles south of the margin of the pre-Cambrian shield.

Whatever the origin of the limestone boulders, the study of their faunas is worth while, because they yield a great variety of unusually well preserved Cambrian trilobites of different ages. The description of the Upper Cambrian faunas has now been completed by the writer, who is undertaking the study of the Lower and Middle Cambrian forms. A few points that are relevant for the phylogeny and classification of trilobites will be briefly discussed.

Beecher divided the trilobites into three orders, Hypoparia, Opisthoparia, and Proparia, according to the character of the cephalic sutures. In the Hypoparia, the free cheeks were supposed to be represented by a ventral plate, and the marginal suture that separates it from the cranidium was homologized with the facial suture of the other two orders. Since the eyes of proparian and opisthoparian trilobites, whenever present, are invariably situated on the course of the facial sutures, Beecher could not consider the eyes of such forms as *Tretaspis* and *Harpes* (which are situated in the middle of the cheeks and not on

the marginal suture) as homologous with the eyes of other trilobites. Several paleontologists, among them, Swinnerton, Richter, and Stubblefield, sharply criticized Beecher's order, Hypoparia, by bringing arguments to show that the eyes of *Tretaspis* and *Harpes* are homologous with the eyes of other trilobites, being situated on the fused facial sutures; whereas, the marginal suture was developed secondarily and does not correspond to the facial suture of the Opisthoparia and Proparia.

The writer believes he has discovered the most convincing case for the homology of the eyes in trilobites, with and without facial sutures. A late Upper Cambrian genus from the boulders in the Lévis shale, *Loganopeltoides*, has eyes and sutures of a peculiar shape, suggesting that the dorsal sutures are on the way to becoming reduced. An early Canadian genus from the same locality, *Loganopeltis*, is almost identical with the preceding, except that the dorsal sutures have become entirely fused; the eyes have preserved the same position. According to Beecher, *Loganopeltis* should be styled a hypoparian form; but it is almost impossible to believe that these two trilobites are not close relatives, and that the eyes in both forms are not homologous (Rasetti, 1945d).

Another group of trilobites that has attracted the writer's attention is represented by the Eodiscids. These small trilobites, chiefly characterized by the cephalon and pygidium of subequal size and by possessing only two or three thoracic segments, appeared in Early Cambrian time and became extinguished before the end of the Medial Cambrian. Here again, we have a case that shows the exaggerated importance attributed to the facial sutures by Beecher and his followers. The Eodiscids were supposed to belong to the Hypoparia, since the forms known in Beecher's time had no dorsal sutures. Walcott, however, discovered, in the Middle Cambrian of the Cordilleran province, the genus *Pagetia*, which is, in most respects, almost identical with *Eodiscus*, excepting the presence of small free cheeks of the proparian type. It is difficult to deny the close relationship between the two genera.

The Lower and, possibly, Middle Cambrian boulders in the conglomerates of the Lauzon formation yield a remarkable variety of Eodiscids, with eyes and free cheeks. Some of these have been assigned by the writer to the genus *Pagetia*, some to a new genus, *Paget-*

ides (Rasetti, 1945a). Furthermore, a restudy of certain forms from other localities showed that *Microdiscus connexus* Walcott, from the Lower Cambrian Schodack formation of New York, originally described as blind, has eyes and free cheeks; and that a species of *Pagetides* occurs in the Parker shale of northwestern Vermont. This definitely shows that trilobites with facial sutures of the proparian type, supposed by Beecher to be the most advanced, already existed in the Early Cambrian; as a matter of fact, we do not know which is the more primitive condition in the Eodiscids, the presence or the absence of eyes and dorsal sutures. It must be understood that there is not the slightest indication that these proparian Eodiscids were the ancestors of the post-Cambrian Proparia. The writer believes that the Eodiscids should constitute a separate order, since we do not know anything even remotely resembling a transitional form, between the Eodiscids and the multisegmented trilobites. The Eodiscids have long been associated with the Agnostids, but the writer agrees with most modern authors in considering the two groups as entirely unrelated.

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1945d. Am. J. Sci. **243**: 44–50.

SECTION OF BIOLOGY

FEBRUARY 11, 1946

DOCTOR LAURENCE H. SNYDER, Chairman, Department of Zoology and Entomology; and Professor of Medical Genetics, College of Medicine, The Ohio State University, Columbus, Ohio: *Recent Advances in Human Heredity.* (This lecture was illustrated by lantern slides.)

Advances in the basic principles of genetics have been reflected in parallel advances in the application of these principles to man. The study of human heredity has progressed slowly, because it is essentially a study of population genetics, and, as such, requires different techniques than those used in the usual experimental laboratory genetics. These techniques, involving the analysis of gene frequencies, equilibria, contingency tests, twin comparisons, and the like, have been gradually developed and perfected. As a result, there is now available a considerable amount of exact information on the role played by genetic variation in the development of diverse human characteristics. One outcome of the availability of such information is the increasing realization of the importance of a knowledge of human heredity, in modern life. The realization has given rise to the inclusion of courses in medical genetics in the curricula of various medical schools, the setting up of required courses in heredity in various curricula of law, sociology, social administration, psychology, and anthropology, and the presentation of lectures on human heredity under a wide variety of auspices.

The extent and precision of our present knowledge of human heredity warrant the formulation of practical applications to human welfare. These applications include, first, genetic prognosis, that is, the prediction of the appearance or reappearance of hereditary traits within families; second, diagnosis, on the basis of genetic data, of conditions difficult to diagnose readily on other grounds; third, the instituting of preventive measures against certain diseases and anomalies in the relatives of affected individuals; and fourth, medico-legal applications in disputed paternity and identification of individuals, based on the inheritance of specific test characters, such as the blood agglutinogens.

Examples of each of these practical applications have been repeatedly presented and discussed in the literature (*cf.* Macklin, 1940; Snyder, 1941, 1943, 1946b; Muller, Little, and Snyder, 1946; Wiener, 1943).

The basis on which practical applications are built is a body of data, painstakingly gathered and carefully evaluated, about the mutant gene, in general, and concerning the mutant gene in man, in particular. I have classified the basic relations of the mutant gene in man under four main headings: spatial relations, physiological relations, ontogenetic relations, and phylogenetic relations (Snyder, 1942). Knowledge of some of these, in regard to any gene, is essential, and knowledge of all of them is desirable, before formulating a practical application, in regard to the trait conditioned by the gene.

In man, a mutant gene may be autosomal, it may be sex-linked, it may be holandric, or it may be incompletely sex-linked. Its behavior in transmission will depend upon this absolute location. Many examples of each of these types of spatial relationships are now known in human genetics.

Two mutant genes may be independent or linked. Tentative linkage maps for man are now available, both for the sex chromosomes and for the autosomes (Snyder 1946a), and their further extension may be expected to add precision to genetic prognosis and to lead to the early recognition of preclinical symptoms and, thus, to the institution of preventive measures.

Physiological relations of the mutant gene include penetrance, expressivity, and viability. These are all variable, from gene to gene, and require special methods of analysis. A knowledge of these relations is important to genetic prognosis.

Ontogenetic relations include dominance, recessivity, epistasis, hypostasis, and cumulativeness. These are the usual "Mendelian" relationships. They have some special applications in genetic prognosis.

Phylogenetic relations include the frequencies of a gene and of its alleles in the population, and the frequencies of the genotypes resulting from combinations of the gene and its alleles. It is at this point that the study of human genetics differs from the usual laboratory analysis, where the employment of experimental matings insures that the genotype of each individual is known or can be determined. In man, the genotypes of individuals, in the families under observation, are capable, in most cases, only of incomplete specification, and the study of human genetics becomes, in the final analysis, a study of population genetics. Basic statistical researches by many workers, both in this

country and abroad, are constantly improving our methods of analysis of the problems of gene frequencies, equilibria, mutation pressure, selection pressure, and allied phenomena (*cf.* Dobzhansky, 1941; Snyder, 1942, 1946a). Through such basic researches and the careful collection and analysis of human data, the study of human heredity is making rapid strides.

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SECTION OF PSYCHOLOGY

FEBRUARY 18, 1944

DOCTOR KURT LEWIN, Department of Economics and Social Science, Massachusetts Institute of Technology, Cambridge, Massachusetts: *Research in Group Dynamics.*

(No abstract received.)

SECTION OF ANTHROPOLOGY

FEBRUARY 25, 1946

DOCTOR SHERWOOD L. WASHBURN, Department of Anatomy, College of Physicians and Surgeons, Columbia University, New York, N. Y.: *Experimental Anthropology.*

Anthropology is changing rapidly. The last ten years have seen the rise of culture and personality studies. The increased application of anthropological knowledge, during the war, has given a tremendous impetus to applied anthropology.

The dominant emphasis of traditional anthropology, particularly in the United States, was history and explanation of the present in terms of the past. Today, the effort is being made to understand social and physical processes, to analyse in terms of general principles (such as the laws of psychology or genetics).

The change, from a descriptive-historical to an analytic approach, has removed the boundaries of traditional anthropology. Description can be limited to primitive peoples and primates, but psychological principles apply to all mankind, just as biological laws apply to all animals.

Many of the theories which attempt to explain evolutionary change can be tested in the laboratory. Experiments simplify, clarify, and offer new insights into complicated natural processes.

The way in which experiment enters into the theoretical scheme of physical anthropology may be described as follows: The primates are described. Theories attempt to explain what is observed. Then, experiments are performed to test the validity of the theories.

The complementary role of historical and experimental studies may be illustrated by consideration of the human orbit. If one wishes to know the stages through which the orbit has evolved, one must study the primates, particularly the fossils. If one wishes to know what forces shape the orbit, one must experiment. Each type of analysis supplements and enriches the other.

Frequently, when experiments are performed, unsuspected factors are discovered, and these make possible new approaches to history. The experiments which led to the theory of genetics, revolutionized the

theoretical basis of evolution. (The theoretical scheme was illustrated by slides of rat skulls, showing the effects of removal of various muscles and bones.)

There is a strong tendency for sciences to be divided, so that descriptive studies are separated from the complementary and experimental sciences. Anthropology should make every effort to include both forms of knowledge. No thorough understanding of man or his culture is possible without history and experiment.

SECTION OF BIOLOGY

FEBRUARY 8 AND 9, 1946

Conference on *"The Physico-Chemical Mechanism of Nerve Activity."*

The Section of Biology held a Conference on "The Physico-Chemical Mechanism of Nerve Activity," arranged by Doctor David Nachmansohn, College of Physicians and Surgeons, Columbia University, New York, N. Y.

The program consisted of the following papers:

FRIDAY, FEBRUARY 8

Morning Session. Chairman, Tracy J. Putnam, College of Physicians and Surgeons, Columbia University, New York, N. Y.

Opening Address, by Tracy J. Putnam.

"Membrane Theory," by Rudolf Hoeber, University of Pennsylvania, Philadelphia, Pennsylvania.

"Chemical Mechanism of Nerve Activity," by David Nachmansohn.

Afternoon Session. Chairman, John F. Fulton, Yale University, School of Medicine, New Haven, Connecticut.

"An Electrical Hypothesis of Synaptic and Neuromuscular Transmission," by John C. Eccles, University of Otago, Dunedin, New Zealand.

Evening Session. Chairman, Frederic Bremer, University of Brussels, Belgium.

"Chemical Activation of Nervous Function," by Detlev Bronk and Frank Brink, Jr., University of Pennsylvania, Philadelphia, Pennsylvania.

"Electric Characteristics of Electric Tissue," by Richard T. Cox, C. W. Coates, and M. V. Brown, Johns Hopkins University, Baltimore, Maryland; New York Zoological Society; and College of the City of New York, New York, N. Y.

SATURDAY, FEBRUARY 9

Morning Session. Chairman, McKeen Cattell, Cornell University Medical College, New York, N. Y.

"Enzymes as Means of Studying Cellular Function," by David E. Green, College of Physicians and Surgeons, Columbia University, New York, N. Y.

"Cholineesterase," by Oscar Bodansky, Medical Division, Chemical Warfare Service, Edgewood Arsenal, Maryland.

"Effects of Drugs on Nerve Activity," by Alfred Gilman, Medical Division, Chemical Warfare Service, Edgewood Arsenal, Maryland.

Afternoon Session. Chairman, Francis O. Schmitt, Massachusetts Institute of Technology, Cambridge, Massachusetts.

"Regeneration of Nerve Fibers," by Joseph Hinsey, Cornell University Medical College, New York, N. Y.

"Metabolism and Function," by Ralph W. Gerard, University of Chicago, Chicago, Illinois.

SECTION OF BIOLOGY, AND SECTION OF PHYSICS AND CHEMISTRY

FEBRUARY 15 AND 16, 1946

Conference on "*Muscular Contraction.*"

The Sections of Biology, and Physics and Chemistry held a Conference on "Muscular Contraction." Doctor Alexander Sandow, New York University, Washington Square College of Arts and Pure Science, New York, N. Y., was the Conference Chairman, in charge of the meeting.

The program consisted of the following papers:

FRIDAY, FEBRUARY 15

Morning Session: Dynamics. Chairman, Alexander Sandow.

General Introduction, by Alexander Sandow.

"Dynamics of Single Muscle Fibers," by Robert W. Ramsey, Medical College of Virginia, Richmond, Virginia.

"The Time Course of Tension Development in the Muscle Response," by A. S. Gilson, Jr., G. M. Schoepfle, and S. M. Walker, Washington University, School of Medicine, St. Louis, Missouri.

Afternoon Session: Ultrastructure. Chairman, John T. Edsall, Harvard Medical School, Boston, Massachusetts.

"Birefringence and Ultrastructure of Muscle," by Ernst Fischer, Medical College of Virginia, Richmond, Virginia.

"Electron Microscope and X-Ray Diffraction Studies of Muscle Structure," by Francis O. Schmitt, R. S. Bear, C. E. Hall and M. A. Jakus, Massachusetts Institute of Technology, Cambridge, Massachusetts.

"Muscular Contraction and Rubber-like Elasticity," by E. Guth, University of Notre Dame, Notre Dame, Indiana.

SATURDAY, FEBRUARY 16

Morning Session: Chemistry. Chairman, Carl F. Cori, Washington University, School of Medicine, St. Louis, Missouri.

"The Main Chemical Phases of the Recovery of Muscles," by Otto Meyerhof, University of Pennsylvania, Philadelphia, Pennsylvania.

"Chemical Processes of Oxidative Recovery," by Severo Ochoa, New York University, College of Medicine, New York, N. Y.

Afternoon Session: Mechano-Chemical Coupling. Chairman, Wallace O. Fenn, University of Rochester, School of Medicine and Dentistry, Rochester, New York.

"Intracellular Cations and Muscle Actions," by H. B. Steinbach, Washington University, St. Louis, Missouri.

"The Potential Role of the Myosin-ATPase-Calcium Complex in the Activation and Energy Output of Muscle," by Dugald Brown, New York University, College of Dentistry, New York, N. Y.

"Latency Relaxation and a Theory of Muscular Mechano-chemical Coupling," by Alexander Sandow, New York University, Washington Square College, New York, N. Y.

NEW MEMBERS

Elected February 28, 1946

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Browne, Dudley, Chemistry, Pharmacology, Biology. Asst. Vice President and Research Coordinator, American Home Products Corp., New York, N. Y.

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